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On Communication Range Heterogenity in Wireless Sensor Networks

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In this thesis, we investigate how the performance (i.e., the average message delivery delay) of IEEE 802.15.4-based WSNs (Wireless Sensor Networks) is affected by the heterogeneity of wireless communication ranges of sensor nodes. WSNs are the network in which many sensor nodes cooperate to realize tasks by arranging a large number of sensor nodes having wireless communication function and sensing function on a field. WSNs have been used for monitoring and control of construction sites, environmental monitoring and so on. Since the size of the sensor node used for a WSNs is small, it has only a simple function and is often battery driven. An appropriate control of the wireless communication range of a sensor node should be beneficial in terms of reduced power consumption of the sensor node and performance improvement caused by reduced collisions in wireless communication. Utilizing our fluid-based analysis of large-scale IEEE 802.15.4 WSNs, we compare performances of WSNs with different settings of wireless communication ranges and also with three types of node placements (i.e., straight, lattice, and random). We conclude that the wireless communication range heterogeneity could improve (or degrade) the WSN performance and that the degree of improvement (or degradation) is more apparent in larger-scale WSNs than in smaller-scale WSNs. Then, considering the characteristics of WSNs that we have investigated and understood, we propose a wireless communication range adjustment method MCRA (MST-based Communi-

cation Range Adjustment) for sensor nodes in a large-scale wireless sensor network. The basic idea of MCRA is to keep the wireless communication range of each sensor node as small as possible while keeping the minimum number of hops between sensor node and sink node. We investigate the effectiveness of MCRA by using the analysis method of large-scale IEEE 802.15.4 wireless sensor network by showing an example.